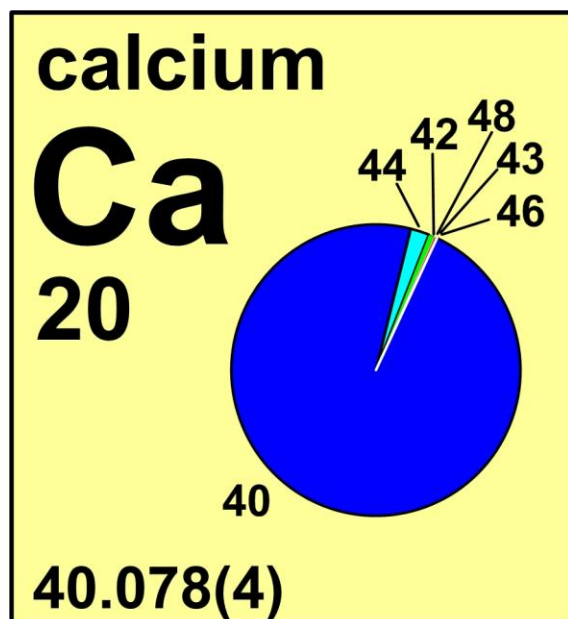





## calcium

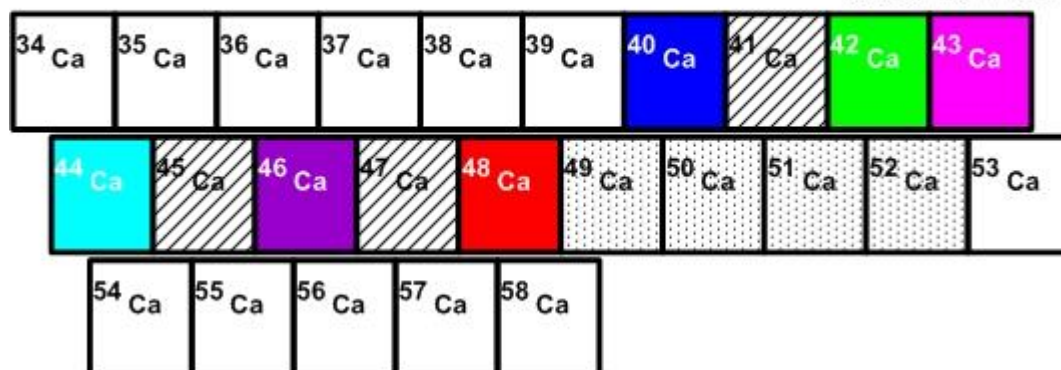


Stable isotope	Atomic mass*	Mole fraction
$^{40}\text{Ca}$	39.962 590 98	0.969 41
$^{42}\text{Ca}$	41.958 618 01	0.006 47
$^{43}\text{Ca}$	42.958 7666	0.001 35
$^{44}\text{Ca}$	43.955 4818	0.020 86
$^{46}\text{Ca}$	45.953 6926	0.000 04
$^{48}\text{Ca}$	47.952 534	0.001 87

\* Atomic mass given in unified atomic mass units, u.

### Half-life of radioactive isotope

Less than 1 second   
 Between 1 second and 1 hour   
 Greater than 1 hour 



## Important applications of stable and/or radioactive isotopes

### Isotopes in medicine

- 1) Stable isotopes  $^{42}\text{Ca}$ ,  $^{44}\text{Ca}$ ,  $^{46}\text{Ca}$ , and  $^{48}\text{Ca}$  are intimately involved with many physiological processes and can be used in various medical diagnostics. At times the amount of a nutrient's bioavailability in a diet can be difficult to determine. The use of stable isotope-labeled food makes this determination easier. Food labeled with a stable isotope of the nutrient of interest is ingested and then fecal matter and urine is tested for the presence and quantity of the isotope. When coupling the ingestion of a first isotope-labeled nutrient with an intravenous injection of a second isotope-label of the same nutrient, this technique can be used as a way to measure absorption of the mineral of interest within the body.

- 2)  $^{42}\text{Ca}$ ,  $^{44}\text{Ca}$ ,  $^{46}\text{Ca}$ , and  $^{48}\text{Ca}$  are used as absorption, metabolism, and bioavailability parameters during tests for space flight, bed rest and physical stress. They are also used in osteoporosis, pregnancy, cystic fibrosis, and diabetes research studies.

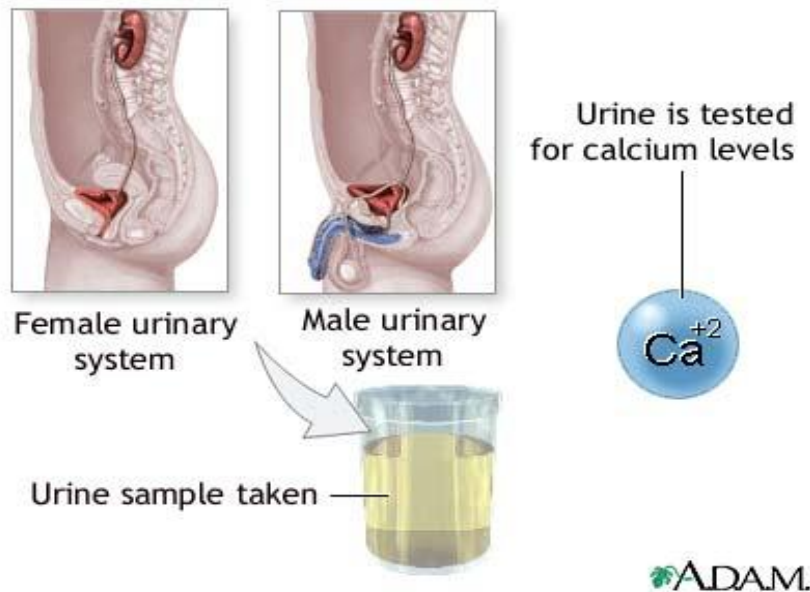


Figure 1: This is a picture of the procedure for the calcium urine test. The urine is collected in a urine cup and then later tested for calcium quantity.

#### Isotopes in tracer studies

- 1)  $^{45}\text{Ca}$  and  $^{47}\text{Ca}$  are radioactive isotopes used to study the metabolism and movement of calcium in the body. An example of calcium isotopes in use: a patient will be injected with either  $^{45}\text{Ca}$  or  $^{47}\text{Ca}$ . The isotope enters the bloodstream and the flow of radioactivity in bloodstream can be followed and the path determined. The medical specialist can use this information to find out if the body is using calcium properly in creating bones and in correctly regulating nerve messages.
- 2)  $^{45}\text{Ca}$  is also used to study calcium behavior in soils, detergents, water purification systems and glassy materials. The radioactive isotope,  $^{45}\text{Ca}$  is introduced to a system and monitored, measuring various types of calcium-related behavior within the system and also looking at how calcium of one system may interact with another. For example calcium of soil mixing with that of fertilizers.

#### Isotopes in stellar studies

- 1)  $^{41}\text{Ca}$  is most often used in stellar studies.  $^{41}\text{Ca}$  is the most likely candidate for these types of studies because it decays to  $^{41}\text{K}$ , which is a critical indicator of anomalies that occur in the solar system.